red dots, or letters, or some such device printed on the map. This is, however, a small detail, and on the whole the book is one which we hope will be imitated for other holiday resorts.

Economics: An Introduction for the General Reader. By Henry Clay. Pp. xvi + 476. (London: Macmillan and Co., Ltd., 1916.) Price 3*s.* 6*d.* net.

MR. CLAY has written a meritorious, in many ways an excellent, book; but, though his style is good and his reasoning clear, he has neither the elevated clarity of Bagehot nor the racy charm of Mr. Hartley Withers. Very rightly has he laid special emphasis both on the problems which border the two provinces of politics and ethics and on such essentially vital questions as speculation and wages. Indeed, his chapters on these last-mentioned subjects, amongst the best in the book, merit the highest praise. But the pages on banking, though containing an interesting discussion of the principles of finance, would, we fear, with their continual glib references to "runs," "liquid assets," etc., prove difficult reading for, let us say, a tutorial class; nor are such sentences as: "There is an 'intensive' as well as an 'extensive' margin of cultivation . . ." very delectable nourishment for the general reader.

The book, in fact, though in many ways an excellent elementary treatise on economics, is essentially academic.

The scope of the work has already been indicated, and includes the ordinary principles, money, banking, and finance. But it is not quite clear why Mr. Clay should consider that "the object . . . of economics is explanation solely," or that "ought" must necessarily involve a moral content. Surely it is arguable that any teleological conception may involve an appendent obligation, and that economics is a normative science. May we add that the absence of an index is not the criterion of popularity? A. L.

Methods in Practical Petrology: Hints on the Preparation and Examination of Rock Slices. By H. B. Milner and G. M. Part. Pp. vii + 68. (Cambridge: W. Heffer and Sons, Ltd., 1916.) Price 2*s.* 6*d.* net.

THIS little book cannot be regarded as in any sense a complete exposition of the subject, but it contains some useful suggestions, especially on section-cutting and simple microchemical methods, incuding staining. It was, however, hardly necessary to give directions for the preparation of well-known dyes, such as fuchsine, malachite-green, and methylene-blue. We are even told how to prepare nitroso-dimethyl-aniline, one of the substances employed in the production of methylene-blue. Several pages are devoted to the subject of the classification of rocks, which is necessarily so briefly treated as to be somewhat misleading in places. If these digressions had been omitted, space would have been obtained for a more extended consideration of the practical methods with which the book is primarily concerned.

LETTERS TO THE EDITOR.

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Negative Liquid Pressure at High Temperatures.

IT must have been remarked in the discussions of the various forms of equation of state for vapour-liquid (*cf.* K. Onnes and Keesom, "Ency. der Math.," or in Leyden Communications, xi., 1912, p. 727) that this equation should determine the range of possible negative pressures in liquid. If we could assume the van der Waals form of equation to hold over the wide range that is concerned, it would readily follow that negative pressure could subsist only at absolute temperatures below 27/32 of the critical point of the substance. For water the latter is 365° C.; thus in that substance internal tension could (theoretically) persist up to 538° absolute, which is 265° C. Such an order of magnitude appears at first sight surprisingly high, though really there is nothing to compare it with. By an oversight I have recently (Proc. Lond. Math. Soc., 1916, p. 191) quoted the critical point of water as 365° absolute, and so obtained the much lower limit 35° C.; and it was a reference to experiments by Prof. H. H. Dixon (Proc. R. Dublin Soc., 1914, p. 233), realising, for vegetable sap, tensions of the order of a hundred atmospheres at temperatures around 80° C., that has given rise to this correction. JOSEPH LARMOR.

Cambridge, June 24.

Science, Scholarships, and the State.

ALL scientific men must welcome the renewed vigour of the campaign for a recognition of science by the State, and incidentally for the introduction of scientific instruction into our public schools, a campaign in which NATURE has taken so prominent a part. I have followed with the greatest interest the pronouncements of the many eminent men on the subject of science and Government published from time to time, and in view of the greatness of the authorities who have written on the question it is with considerable diffidence that I direct attention to what seems to be an oversight in many of the views put forward as to the proper way to give science its due in England.

I refer to the continued proposals to found fresh scholarships for the encouragement of scientific research, accompanied as they so often are by statements as to the lack of trained men of science. In view of the present (or rather, as I have no actual experience of the present conditions in England, let us say the pre-war) attitude of the State, the universities, and private enterprise towards the men already trained, it seems to me futile to make plans for training fresh men until very definite steps have been taken to see that there are to be recognition and scope granted to them when trained. Anyone who has a knowledge of the typical careers of the most successful (from a scientific point of view) students and younger research workers will readily understand the state of things I have in mind. If a concrete example is required, the case of the 1851 Exhibition scholars may be cited: I choose this case as those scholarships are in the nature of State institutions. They would seem to be exactly of the type intended by the advocates of the establishment of new scholarships; they are, according to the conditions of award (so far as I can recollect

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them), granted for promise shown in scientific research to students whose work is considered likely to be of benefit to the nation and national industries. The men who have held these scholarships for two or three years form a body highly trained in the best English and Continental universities, with, in most cases, considerable research experience under varied conditions and breadth of view. Yet we see on all hands these men barely able to make a living (unless they go to America). They are in general men of all-round education, with specialised knowledge in science in addition; they are not particularly uncouth, unpractical, or unbalanced, as popular tradition would have men of science to be. It is this addition of specialised knowledge that, under present conditions, is the greatest obstacle to their earning a living; they would probably be better paid if they turned their hand to any employment other than the pursuit of science, or became the worst paid of Government clerks

In case I should be supposed to be taking a sordid view and claiming riches for the man of science, I explain that when I write "earning a living" I mean earning just sufficient to enable a *single* man to live in the most modest way befitting a member of a learned profession, and I state without fear of contradiction that to do so was a matter of grave difficulty for our younger men of science before the war.

There is nothing unique about the treatment of the 1851 Exhibition scholars. Taking scientific research workers in general, the State has nothing to offer them except occasional grants of 5*l*. or 10*l*. towards purchasing apparatus; the modern universities offer them (and the offer is widely accepted) 150*l*. or so a year (see the advertisement columns of NATURE) for lecturing on the higher and lower branches of their science, and for spending all their spare time in research; private enterprise treats them as amiable eccentrics on a par with the pleasant gentlemen who devise in our popular papers and magazines problems dealing with the joint ages of old families, and the division of ridiculously shaped fields into absurd areas. Only their love of science keeps them employed on scientific work, and you are not likely to extend the class of men willing to accept scholarships under such conditions and with such prospects, however many scholarships you may offer.

So long as the present attitude towards science and scientific workers obtains it is useless to train fresh men, and by means of scholarships to set keen workers on a path which leads them through the pleasant fields of scientific discovery to the pathless waste of apathy and neglect which lies in the way of all workers in pure science in England, a waste where material life is very scarcely nourished. Once the waste is abolished the path need not be made so smooth. To drop the obscurity of metaphor, once show the young and keen student that he has some hopes of employment for his activities and recognition for his work, that there is some place for him in national life when he is accomplished as a research worker, and he will derive more encouragement from the prospect of some future definite goal than from all the help by the way to nowhere offered by scholarships, exhibitions, and such like. These are of little use until there is good prospect of the attitude of the governing classes towards science being changed, and, in my humble opinion, all energies should be devoted to bringing about this change of opinion. It is conceivable that a refusal by our great men of science to do national work for nothing but scant and grudging thanks would do more to increase the national reputation of science than any sort of begging for scholarships. It would mark a new era, when the man of science will be held worthy of his hire, and not as one rather permitted to exist than encouraged; and who will be found to say that such a new era would be a bad thing?

One further point. All present discussion seems to be concerned only with the direct application of science to industry, and not at all with the advisability of encouraging pure science. Many of us would welcome a definite pronouncement from the leading authorities as to their attitude towards pure science. If only science which can be immediately applied to industrial processes is in future to be considered of national value, let us have a clear announcement to this effect from some responsible body. This will give those of us who have spent their youth working in pure science, and who are now on active service, a fair opportunity to set about cultivating the correct attitude of mind towards science before returning to peace-time pursuits. For an attitude of mind is one of the few things easily cultivated within range of German guns. E. N. DA C. ANDRADE.

B.E.F., France, June 21.

On the "Wolf-note" of the Violin and 'Cello.

IT has long been known that on all musical instruments of the violin family there is a particular note which is difficult to excite in a satisfactory manner, and that when this "wolf-note," as it is called, is sounded, the whole body of the instrument vibrates in an unusual degree, and it seems to have been also understood that the difficulty of eliciting a smooth note of this particular pitch is due in some way to the sympathetic resonance of the instrument (Guillemin, "The Applications of Physical Forces," 1877). In a recent paper (Proc. Camb. Phil. Soc., June, 1915) G. W. White has published some experimental work confirming this view. The most striking effect noticed is the *cyclical* variation in the intensity of the tone obtained when the instrument is forced to speak at this point. White suggests as an explanation of these fluctuations of intensity that they are due to the beats which accompany the forced vibration imposed on the resonator. The correctness of this suggestion seems open to serious criticism. For the beats which are produced when a periodic force acts on a vibrator are essentially *transitory* in character, whereas in the present case the fluctuations in intensity are *persistent*.

The following explanation of the effect, which is different from that suggested by White, occurred to me some time ago on theoretical grounds, and has since been confirmed by me experimentally. The effect depends on the fact (which is itself a consequence of theory) that when the pressure with which the bow is applied is less than a certain critical value proportionate to the rate of dissipation of energy from the string, the principal mode of vibration of the latter, in which the fundamental is dominant, is incapable of being maintained and passes over into one in which the octave is prominent. When the bow sets the string in vibration the instrument is strongly excited by sympathetic resonance, and the rate of dissipation of energy rapidly increases and continues to increase beyond the limit up to which the bow can maintain the string in the normal mode of vibration. The form of vibration of the string then alters into one in which the fundamental is feeble compared with the octave. Following this, the amplitude of vibration of the belly decreases, but this change lags behind that of the string to a considerable extent. When the rate of dissipation of energy again falls below the critical limit, the string begins to regain its original form of vibration with the dominant fundamental. This is accordingly followed, after an interval, by a fresh increase in the vibration of the belly, and the cycle then repeats itself indefinitely.

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